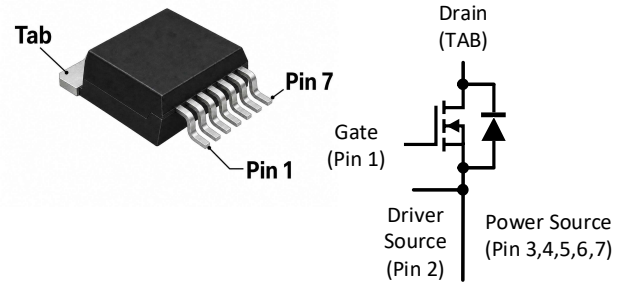


# ICE30M120B7 Silicon Carbide Power MOSFET

## Features

- 1200V 30mohm SiC MOSFET
- Low on-resistance
- Fast switching speed with low capacitances
- Fast intrinsic diode with low reverse recovery ( $Q_{rr}$ )
- Optimized design for High Power SMPS, EV-Charging, Online UPS/HVDC, String Inverters and Solar power optimizer

| Product Summary |                        |              |     |
|-----------------|------------------------|--------------|-----|
| $I_D$           | $T_A=25^\circ\text{C}$ | 76A          | Max |
| $V_{(BR)DSS}$   | $T_C=25^\circ\text{C}$ | 1200V        | Min |
| $r_{DS(on)}$    | $V_{GS}=18\text{V}$    | 30m $\Omega$ | Typ |
| $Q_g$           | $V_{DS}=800\text{V}$   | 110nC        | Typ |



**Maximum ratings**<sup>a</sup>, at  $T_j=25^\circ\text{C}$ , unless otherwise specified

| Parameter                       | Symbol                | Conditions                                                                       | Value       | Unit             |
|---------------------------------|-----------------------|----------------------------------------------------------------------------------|-------------|------------------|
| Continuous drain current        | $I_D$                 | $T_c=25^\circ\text{C}$                                                           | 76          | A                |
|                                 |                       | $T_c=100^\circ\text{C}$                                                          | 54          |                  |
| Pulsed drain current            | $I_{D, \text{pulse}}$ |                                                                                  | 228         | A                |
| Maximum gate source voltage     | $V_{GS(max)}$         |                                                                                  | -12/+24     | V                |
| Operational gate source voltage | $V_{GS \text{ op}}$   |                                                                                  | -5/+18      | V                |
| Single pulsed Avalanche energy  | $E_{AS}$              | $L=0.5\text{mH}$ , $V_{DD}=50\text{V}$ ,<br>$I_{AS}=45\text{A}$ , $R_G=50\Omega$ | 506         | mJ               |
| Power dissipation               | $P_{tot}$             |                                                                                  | 375         | W                |
| Storage temperature             | $T_{stg}$             |                                                                                  | -55 to +175 | $^\circ\text{C}$ |
| Operating temperature           | $T_j$                 |                                                                                  |             |                  |

<sup>a</sup> Pulse width limited by  $T_{jmax}$

| Parameter | Symbol | Conditions | Values |     |     | Unit |
|-----------|--------|------------|--------|-----|-----|------|
|           |        |            | Min    | Typ | Max |      |

### Thermal characteristics

|                                                             |            |                                     |   |   |     |      |
|-------------------------------------------------------------|------------|-------------------------------------|---|---|-----|------|
| Thermal resistance, junction-case                           | $R_{thJC}$ |                                     | - | - | 0.4 | °C/W |
| Thermal resistance, junction-ambient                        | $R_{thJA}$ | leaded                              | - | - | 40  |      |
| Soldering temperature, wave soldering only allowed at leads | $T_{sold}$ | 1.6mm (0.063in.) from case for 10 s | - | - | 260 | °C   |

### Electrical characteristics<sup>a</sup>, at $T_j=25^{\circ}\text{C}$ , unless otherwise specified

#### Static characteristics

|                                  |               |                                                    |      |     |           |            |
|----------------------------------|---------------|----------------------------------------------------|------|-----|-----------|------------|
| Drain-source breakdown voltage   | $V_{(BR)DSS}$ | $V_{GS}=0V, I_D=100\mu A$                          | 1200 | -   | -         | V          |
| Gate threshold voltage           | $V_{GS(th)}$  | $V_{DS}=V_{GS}, I_D=13mA$                          | 2    | 3   | 4         |            |
|                                  |               | $V_{DS}=V_{GS}, I_D=13mA, T_j=175^{\circ}\text{C}$ | -    | 2.2 | -         |            |
| Zero gate voltage drain current  | $I_{DSS}$     | $V_{DS}=1200V, V_{GS}=0V$                          | -    | 5   | 50        | $\mu A$    |
| Gate source leakage current      | $I_{GSS}$     | $V_{GS}=-12/+24V, V_{DS}=0V$                       | -    | -   | $\pm 100$ | nA         |
| Drain-source on-state resistance | $R_{DS(on)}$  | $V_{GS}=18V, I_D=40A$                              | -    | 30  | 36        | m $\Omega$ |
|                                  |               | $V_{GS}=18V, I_D=40A, T_j=175^{\circ}\text{C}$     | -    | 54  | -         |            |
| Gate resistance                  | $R_G$         | $f=1\text{ MHz}, V_{AC}=25mV$                      | -    | 1.7 | -         | $\Omega$   |

#### Dynamic characteristics

|                              |              |                                                                                   |   |      |   |         |
|------------------------------|--------------|-----------------------------------------------------------------------------------|---|------|---|---------|
| Input capacitance            | $C_{iss}$    | $V_{DS}=800V, V_{GS}=0V, f=100\text{ kHz}, V_{AC}=25mV$                           | - | 2720 | - | pF      |
| Output capacitance           | $C_{oss}$    |                                                                                   | - | 108  | - |         |
| Reverse transfer capacitance | $C_{rss}$    |                                                                                   | - | 6    | - |         |
| $C_{OSS}$ stored energy      | $E_{oss}$    |                                                                                   | - | 47   | - | $\mu J$ |
| Forward transconductance     | $g_{FS}$     | $V_{DS}=20V, I_D=40A$                                                             | - | 22   | - | S       |
| Turn-on delay time           | $t_{d(on)}$  | $V_{DS}=800V, V_{GS}=-4/+18V, I_D=40A, R_G=2.5\Omega$<br>(External), $L=100\mu H$ | - | 12   | - | ns      |
| Rise time                    | $t_r$        |                                                                                   | - | 14   | - |         |
| Turn-off delay time          | $t_{d(off)}$ |                                                                                   | - | 24   | - |         |
| Fall time                    | $t_f$        |                                                                                   | - | 9    | - |         |
| Turn-on switching energy     | $E_{ON}$     | Diode:<br>Body Diode at $V_{GS}=-4V$                                              | - | 315  | - | $\mu J$ |
| Turn-off switching energy    | $E_{OFF}$    |                                                                                   | - | 46.2 | - |         |

| Parameter | Symbol | Conditions | Values |     |     | Unit |
|-----------|--------|------------|--------|-----|-----|------|
|           |        |            | Min    | Typ | Max |      |

### Dynamic characteristics

|                           |              |                                                                                                              |   |     |   |         |
|---------------------------|--------------|--------------------------------------------------------------------------------------------------------------|---|-----|---|---------|
| Turn-on delay time        | $t_{d(on)}$  | $V_{DS}=800V, V_{GS}=-4/+18V,$<br>$I_D=40A, R_G=2.5\Omega$<br>(External), $L=100\mu H,$<br>$T_j=175^\circ C$ | - | 11  | - | ns      |
| Rise time                 | $t_r$        |                                                                                                              | - | 16  | - |         |
| Turn-off delay time       | $t_{d(off)}$ |                                                                                                              | - | 28  | - |         |
| Fall time                 | $t_f$        |                                                                                                              | - | 9   | - |         |
| Turn-on switching energy  | $E_{ON}$     | Diode:<br>Body Diode at $V_{GS}=-4V$<br>$T_j=175^\circ C$                                                    | - | 363 | - | $\mu J$ |
| Turn-off switching energy | $E_{OFF}$    |                                                                                                              | - | 70  | - |         |

### Gate Charge Characteristics

|                       |          |                                                  |   |     |   |    |
|-----------------------|----------|--------------------------------------------------|---|-----|---|----|
| Gate to source charge | $Q_{gs}$ | $V_{DS}=800V, I_D=40A,$<br>$V_{GS}=-4$ to $+18V$ | - | 34  | - | nC |
| Gate to drain charge  | $Q_{gd}$ |                                                  | - | 34  | - |    |
| Gate charge total     | $Q_g$    |                                                  | - | 110 | - |    |

### Reverse Diode

|                               |          |                                                                         |   |      |    |    |
|-------------------------------|----------|-------------------------------------------------------------------------|---|------|----|----|
| Continuous forward current    | $I_S$    | $V_{GS}=-4V$                                                            | - | -    | 76 | A  |
| Diode forward voltage         | $V_{SD}$ | $V_{GS}=-4V, I_{SD}=20A$                                                | - | 4.2  | -  | V  |
|                               |          | $V_{GS}=-4V, I_{SD}=20A,$<br>$T_j=175^\circ C$                          | - | 3.7  | -  |    |
| Reverse recovery time         | $t_{rr}$ | $V_{GS}=-4V, V_{RR}=800V,$<br>$I_{SD}=40A,$<br>$d_i f/d_t=1300 A/\mu s$ | - | 18.5 | -  | ns |
| Reverse recovery charge       | $Q_{rr}$ |                                                                         | - | 175  | -  | nC |
| Peak reverse recovery current | $I_{rm}$ |                                                                         | - | 17.5 | -  | A  |

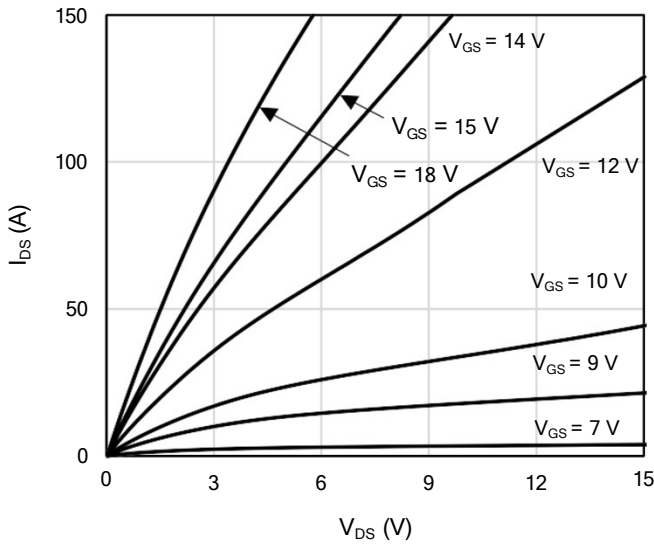


Figure 1: Output Characteristics  $T_J = -40^\circ\text{C}$

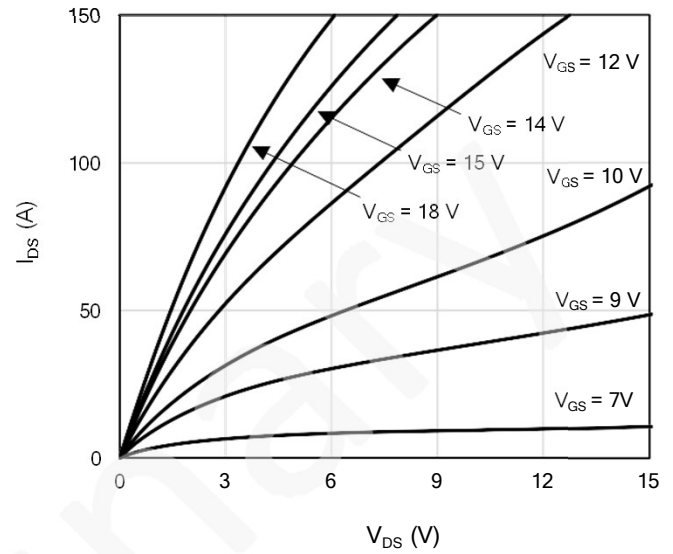


Figure 2: Output Characteristics  $T_J = 25^\circ\text{C}$

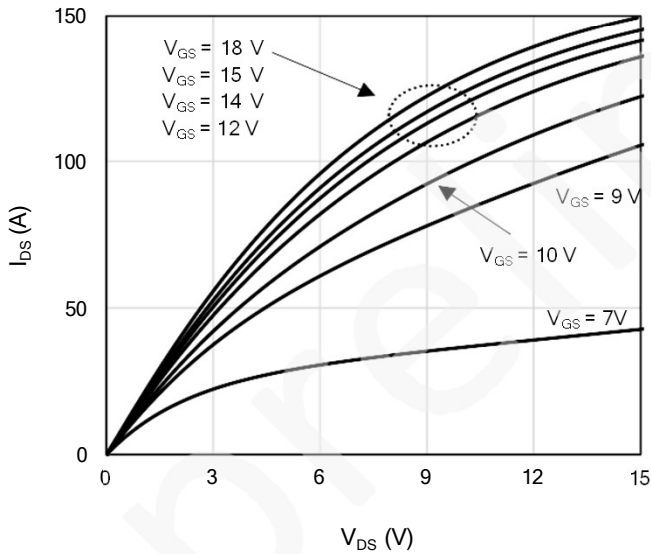


Figure 3: Output Characteristics  $T_J = 175^\circ\text{C}$

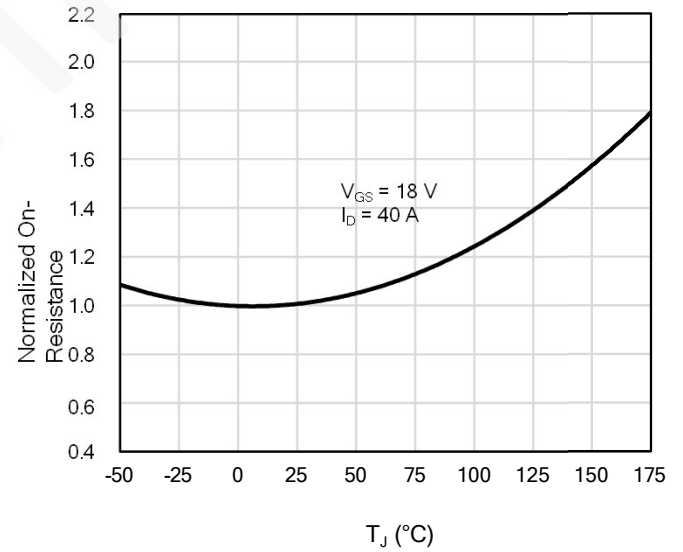


Figure 4: Normalized On-Resistance vs. Temperature

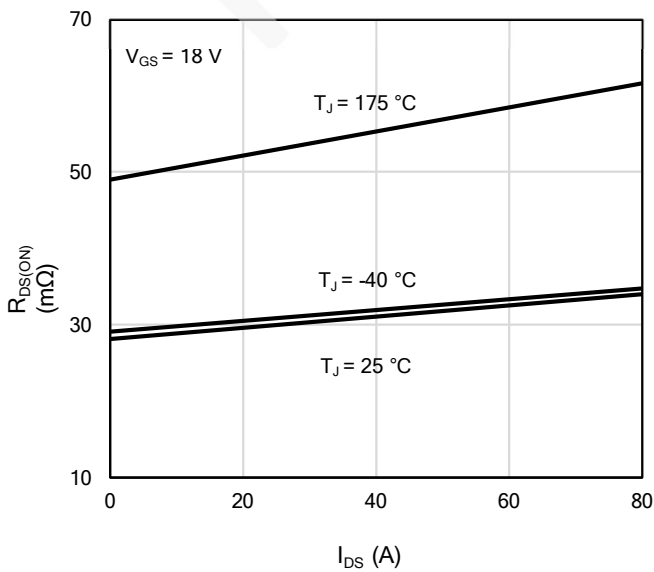


Figure 5: On-Resistance vs. Drain Current  
For Various Temperatures

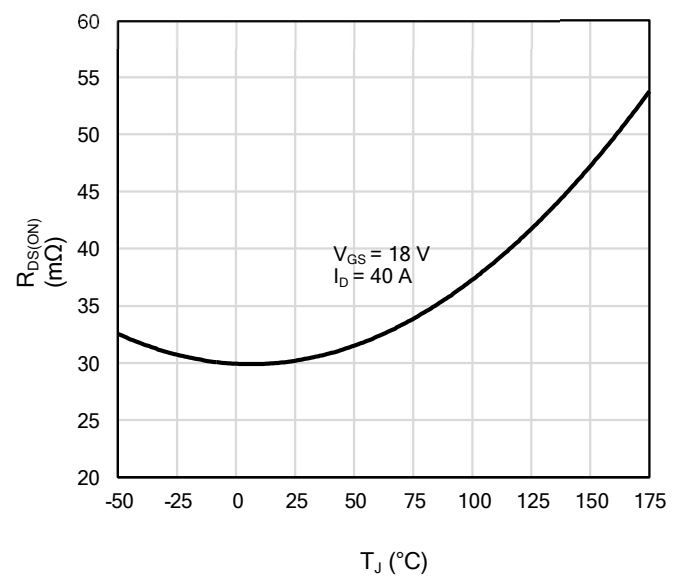


Figure 6: On-Resistance vs. Temperature

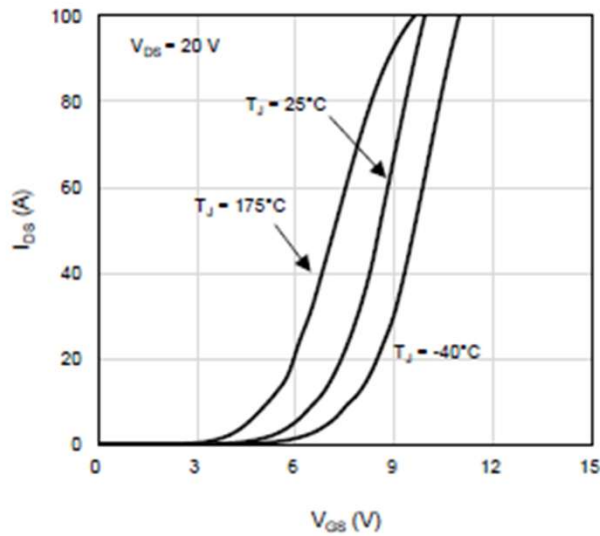


Figure 7: Transfer Characteristics For Various Junction Temperature

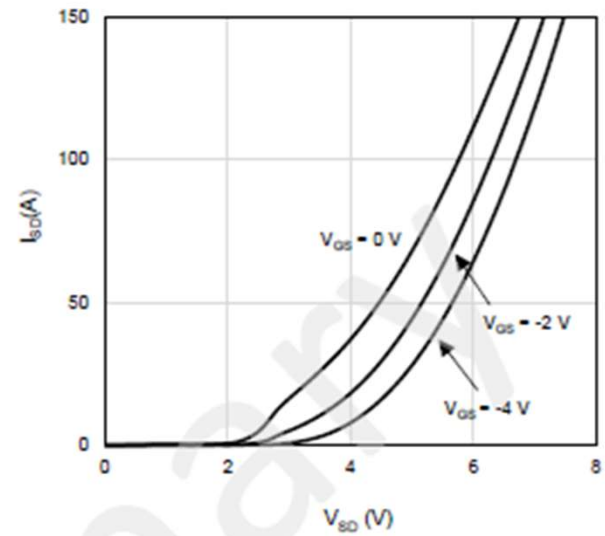


Figure 8: Body Diode Characteristics at  $-40^\circ\text{C}$

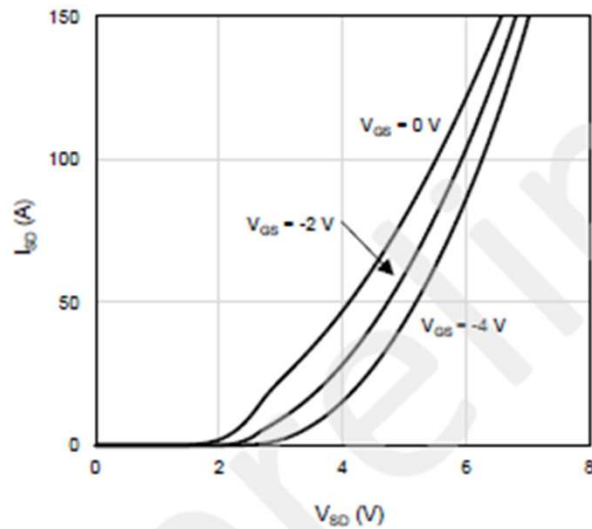


Figure 9: Body Diode Characteristics at  $25^\circ\text{C}$

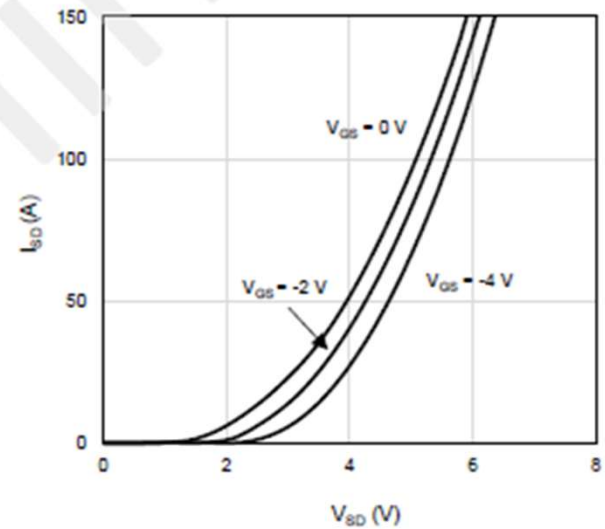


Figure 10: Body Diode Characteristics at  $175^\circ\text{C}$

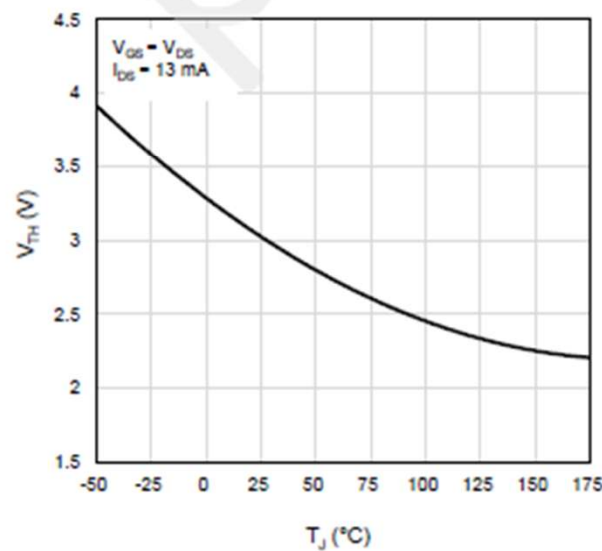


Figure 11: Threshold Voltage vs. Temperature

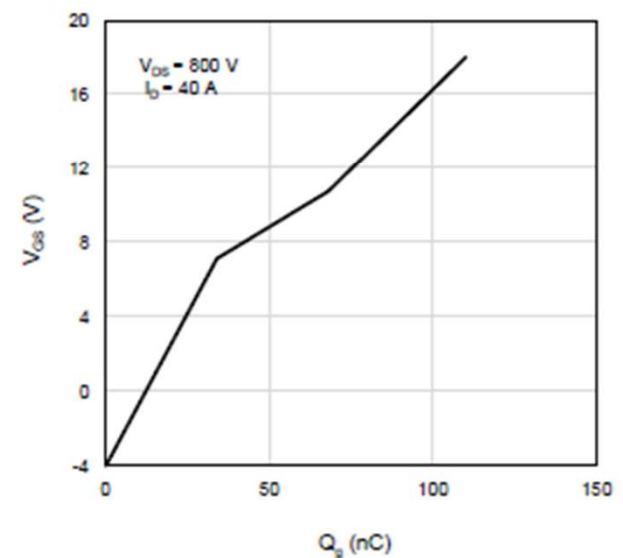


Figure 12: Gate-Charge Characteristics

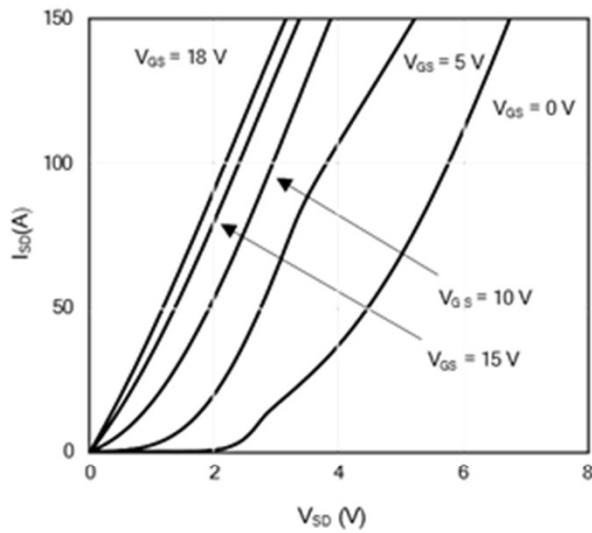


Figure 13: 3rd Quadrant Characteristics at  $-40^{\circ}\text{C}$

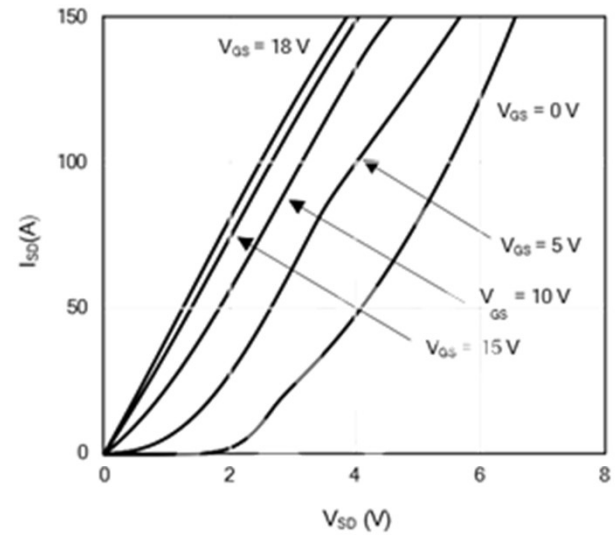


Figure 14: 3rd Quadrant Characteristics at  $25^{\circ}\text{C}$

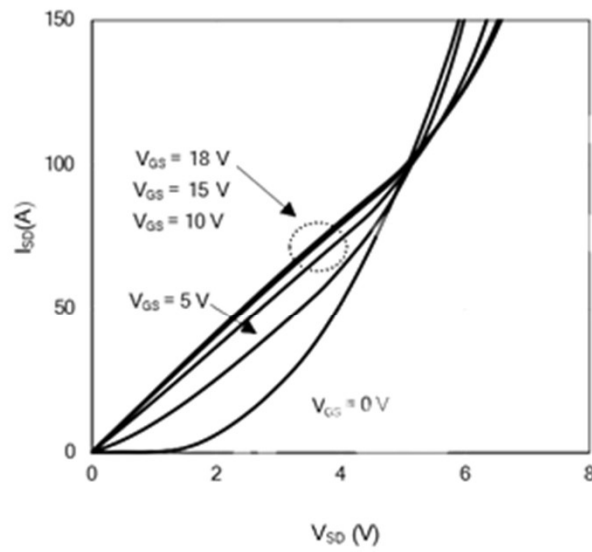


Figure 15: 3rd Quadrant Characteristics at  $175^{\circ}\text{C}$

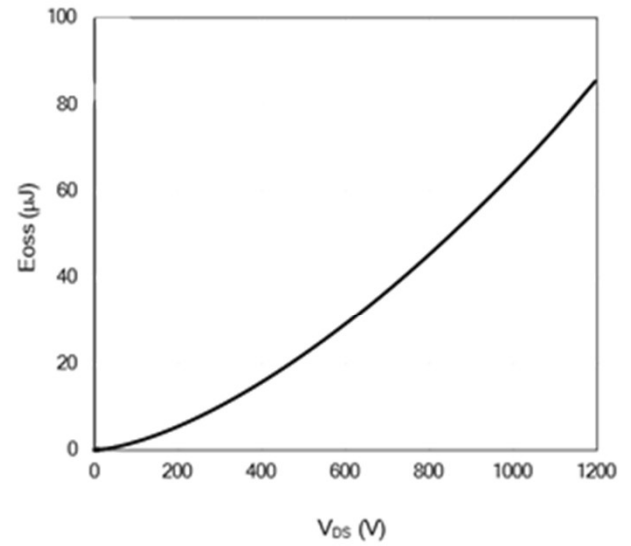


Figure 16: Output Capacitor Stored Energy

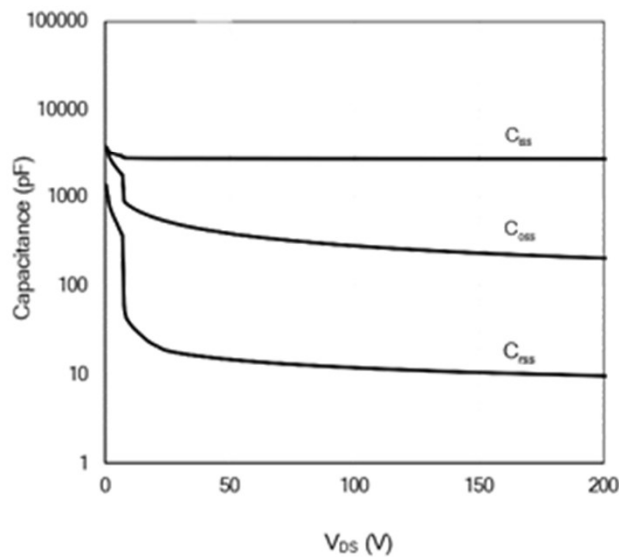


Figure 17: Capacitance Characteristics (0 - 200 V)

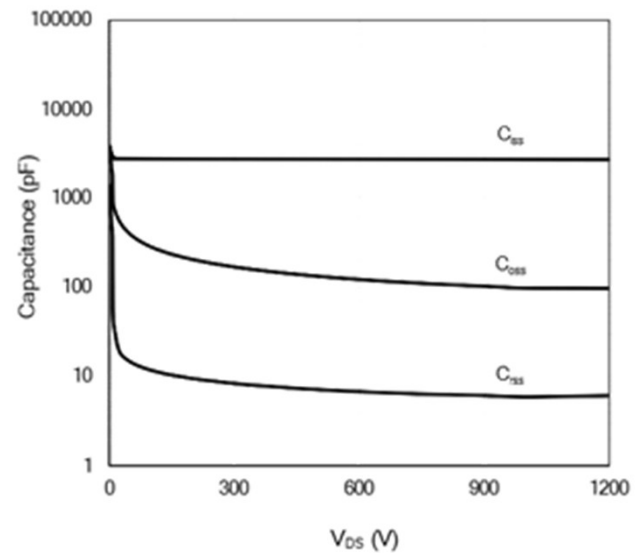


Figure 18: Capacitance Characteristics (0 - 1200 V)

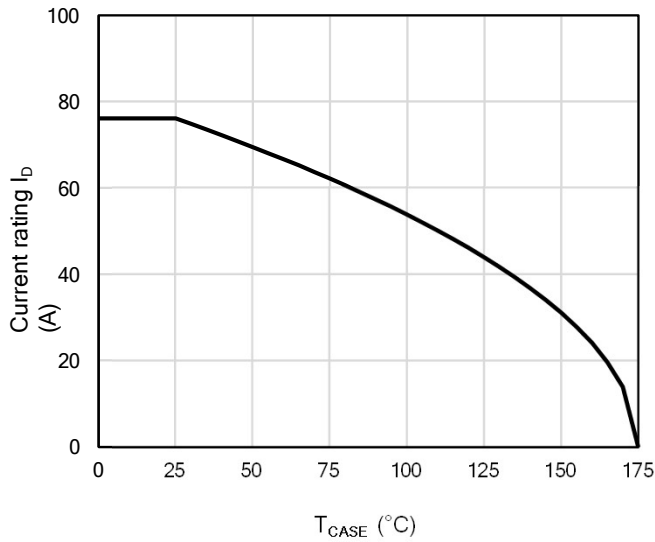


Figure 19: Current De-rating

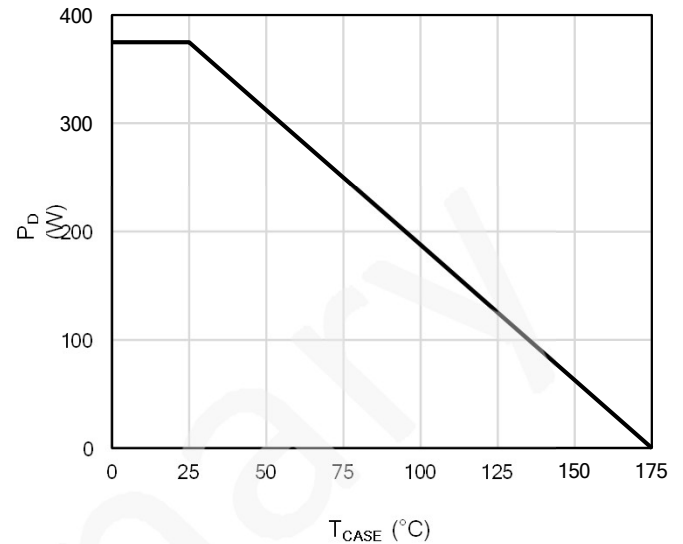


Figure 20: Maximum Power Dissipation Derating vs. Case Temperature

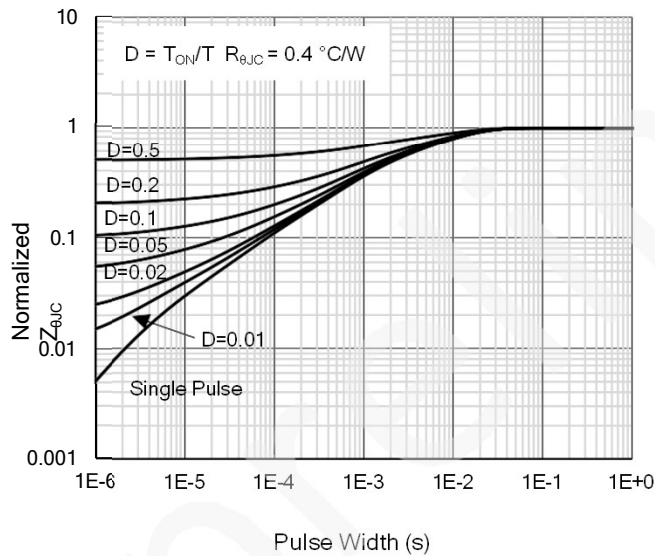


Figure 21: Normalized Maximum Transient Thermal Impedance

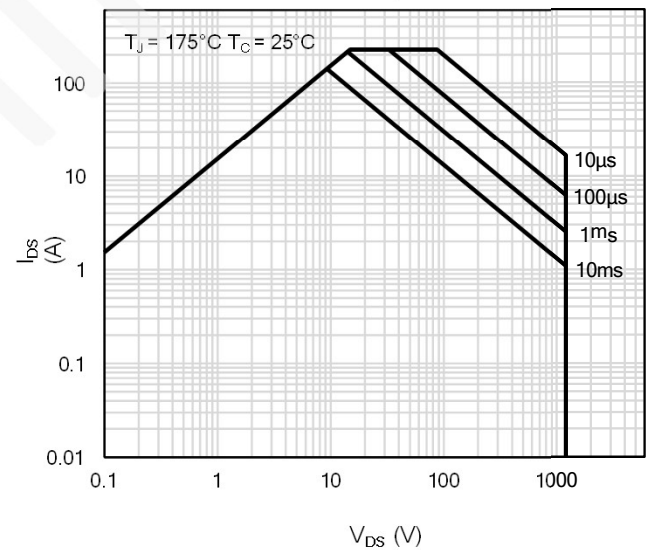


Figure 22: Maximum Forward Biased Safe Operating Area

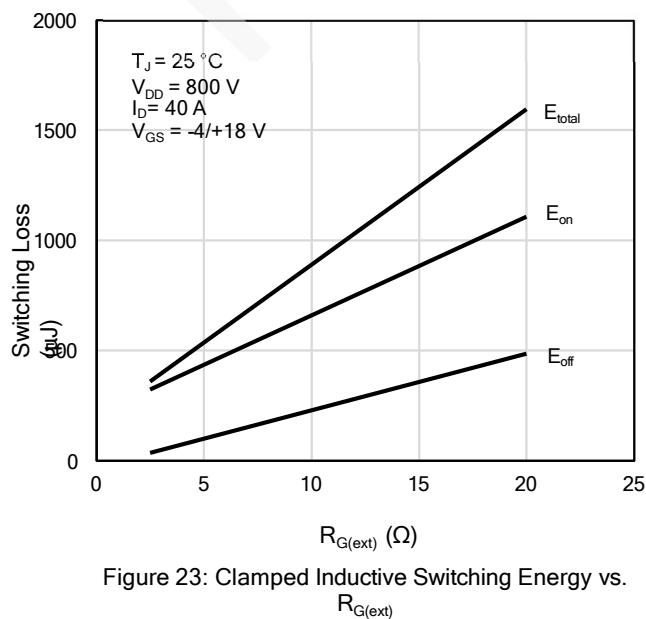


Figure 23: Clamped Inductive Switching Energy vs. R\_G(ext)

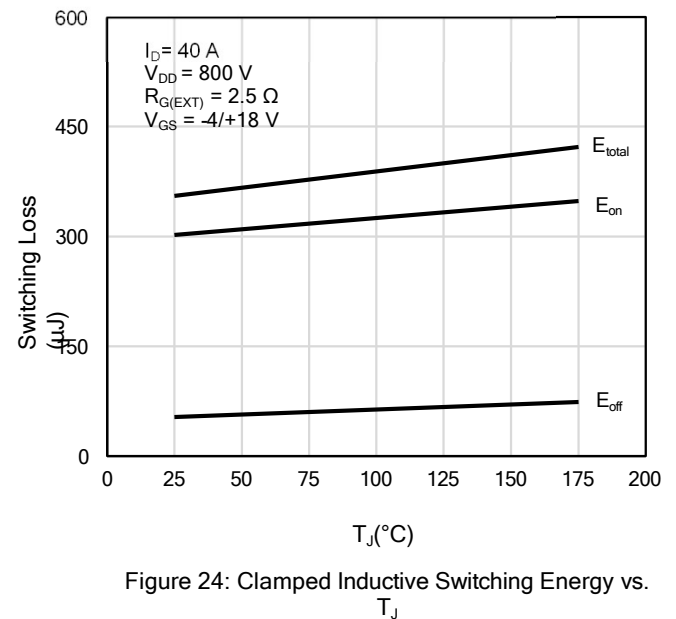


Figure 24: Clamped Inductive Switching Energy vs. T\_J

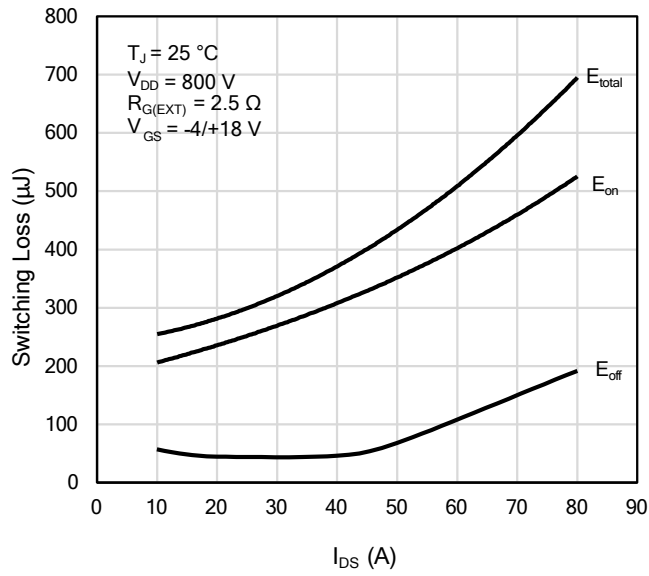


Figure 25: Clamped Inductive Switching Energy vs. Drain Current ( $V_{DD} = 800\text{ V}$ )

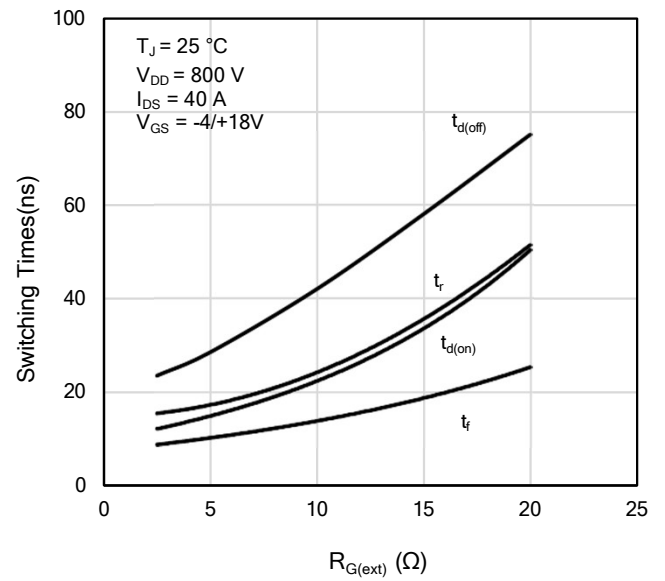
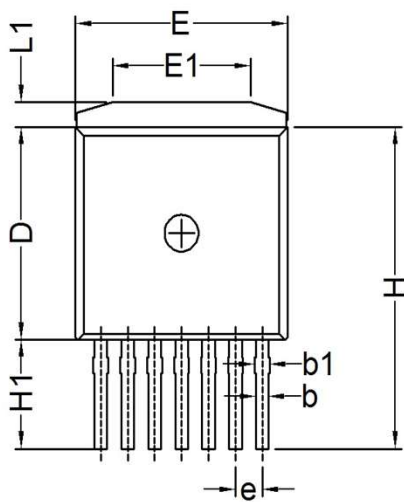
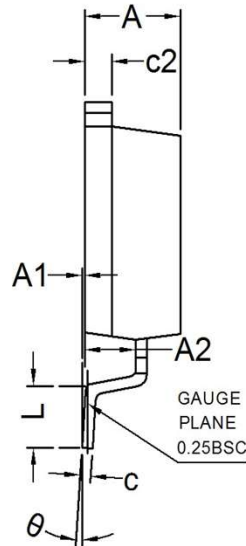


Figure 26: Switching Time vs.  $R_{G(\text{ext})}$

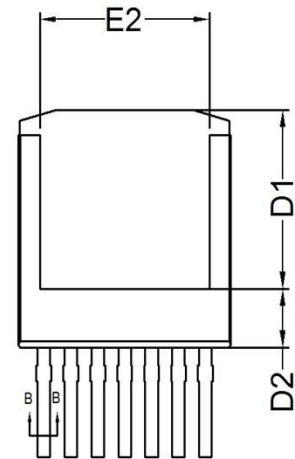
### PACKAGE OUTLINE DRAWING



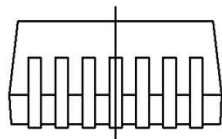
Top View



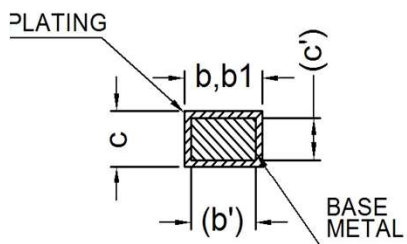
Side View



Bottom View



Side View



View B-B

| SIMBOL   | MIN      | MAX   |
|----------|----------|-------|
| A        | 4.30     | 4.70  |
| A1       | -        | 0.25  |
| A2       | 2.20     | 2.60  |
| b        | 0.52     | 0.72  |
| b'       | 0.50     | 0.70  |
| b1       | 0.60     | 0.80  |
| c        | 0.42     | 0.62  |
| c'       | 0.40     | 0.60  |
| c2       | 1.07     | 1.47  |
| D        | 9.05     | 9.45  |
| D1       | 7.58     | 7.98  |
| D2       | 2.05     | 2.45  |
| E        | 9.80     | 10.20 |
| E1       | 6.30     | 6.70  |
| E2       | 7.80     | 8.20  |
| e        | 1.27 BSC |       |
| L        | 2.48     | 2.88  |
| L1       | 0.87     | 1.27  |
| H        | 14.87    | 15.27 |
| H1       | 4.55     | 4.95  |
| $\theta$ | 0°       | 8°    |

Unit in mm

## Marking Information

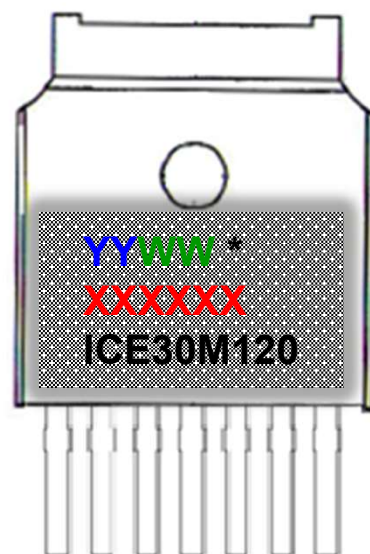
**YY** = Last two digits of the year

**WW** = Work week

**\*** = Site ID

**XXXXXX** = Lot ID

**ICE30M120** = ICE is IceMOS logo and 30M120 is a designated device part number



## Disclaimer

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